APPENDIX 2D

Electrical Engineering Design Criteria

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2D.1 Introduction

This appendix summarizes the codes, standards, criteria, and practices that will be generally used in the design and construction of electrical engineering systems for the Carlsbad Energy Center Project (CECP). More specific project information will be developed during execution of the project to support detailed design, engineering, material procurement specification, and construction specifications.

2D.2 Codes and Standards

The design of the electrical systems and components will be in accordance with the laws and regulations of the federal government and the State of California, City of Carlsbad ordinances, and industry standards. The current issue or revision of the documents at the time of filing this Application for Certification will apply, unless otherwise noted. If there are conflicts between the cited documents, the more conservative requirement will apply.

The following codes and standards are applicable to the electrical aspects of the power facility:

- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- California Code of Regulation (CCR)
- California Public Utilities Commission (CPUC)
- California, State of, Title 24
- Code of Federal Regulation (CFR)
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Illuminating Engineering Society (IES)
- National Association of Corrosion Engineers (NACE)
- National Electrical Code (NEC)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories, Inc. (UL)

2D.3 Substation Switchyard and Transformers

2D.3.1 Switchyard

One set of combustion turbine generator and steam turbine generator will be connected to the existing Encina 230 kV Switchyard. Each combustion turbine generator and steam

turbine generator units via generator step-up transformers will be connected to the grid via transmission lines connection to the ring bus of the existing Encina 230 kV switchyard.

The other set of combustion turbine generator and steam turbine generator via generator step-up transformers will be connected to the grid via transmission lines to the existing 138 kV switchyard. Two of the three existing bays vacated by the retired generating Units 1, 2 and 3 will be re-used for these new generators.

The existing Encina combustion turbine generator connected via a step-up transformer to the existing 138 kV switchyard will provide the black start capability for the new combustion turbine generators. In order to provide black start capability from this generator to the set of combustion turbine and steam turbine generators connected to the 230 kV system, a new 230 kV step-up transformer will be connected in parallel to the existing step-up transformer and via transmission line connection to the ring bus of the existing Encina 230 KV switchyard.

Surge arresters will be provided for the outgoing lines in the area of the takeoff towers.

Disconnect switches will be located at each line termination near the high side connection of the transformer for isolation of the lines and transformer during maintenance. Instrument transformers (current and capacitive voltage transformers) will be included for protection and synchronization.

The transmission line design will meet the requirements of the National Electrical Safety Code—ANSI C2 and CPUC General Order 95. Grounding will be provided to control the step and touch potentials in accordance with IEEE Standard 80, Guide for Safety in AC Substation Grounding. Metallic equipment, structures, and fencing will be connected to the grounding grid of buried conductors and ground rods, as required for personnel safety.

Lightning protection will be provided by shield wires or lightning masts. The lightning protection system will be designed in accordance with IEEE 998 guidelines.

All faults will be detected, isolated, and cleared in a safe and coordinated manner as soon as practical to ensure the safety of equipment, personnel, and the public. Protective relaying will meet IEEE requirements and will be coordinated with the utility.

Transmission lines will have microprocessor-based distance relays with communication capability to the remote substation.

Interface with the utility supervisory control and data acquisition (SCADA) system will be provided. Interface will be at the interface terminal box and the Remote Terminal Units (RTU). Communication between the generation units and the substation at the other end of the overhead transmission lines will be included. RTUs will allow interface and remote control of the switchyards.

The required California Independent System Operator (CAL ISO) revenue metering will be provided on the 230 kV and 138 kV transmission line(s) to record net power to or from the switchyards. Meters and the metering panel will be provided.

2D.3.2 Transformers

One train of Rapid Response Combined Cycle (R2C2) generators will be connected to the 230-kV switchyard through generator step-up transformers. Another set of R2C2 generators will be connected to the 138 kV switchyard through generator step-up transformers. The generator step-up transformers will be two-winding, delta-wye, ONAN/ONAF/ONAF. The neutral point of the high-voltage wye winding will be solidly grounded. Each generator step-up transformer will have metal oxide surge arrestors connected to the high-voltage terminals and will have manual de-energized ("no-load") tap changers located in high-voltage windings.

The step-up transformers will be designed in accordance with ANSI standards C57.12.00, C57.12.90, and C57.91.

The auxiliary power to the plant for each R2C2 train will be provided by two 2-winding auxiliary transformers (13.8 kV/4.16 kV). The high-voltage side (13.8 kV) of the auxiliary transformers will be connected to the line side terminals of each combustion turbine generator's circuit breaker.